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Thermodynamic Properties Related to Expansion of Two-Component Gas

Theoretical equations were derived from basic thermodynamic equations to relate the thermodynamic properties of a two-component gas mixture, consisting of a fixed gas (e.g., helium) and a condensible gas (e.g., nitrogen tetroxide, vaporized from the liquid phase in a tank), to the expansion of the gas during tank ullage blowdown. Experimentally measured values of pressure and temperature were found to be in good agreement with the theoretically predicted data when the effect of heat transfer from the tank wall and liquid surface to the ullage was included in the analysis. The effect of heat transfer becomes important when the expansion occurs over wide pressure ranges in a heavy tank.

Notes:

1. Although the gaseous components were assumed to obey the ideal gas laws, the derivation did not include the assumption that either isentropic or isothermal conditions prevailed during the expansion (blowdown) process.
2. Inquiries concerning this study may be directed to:
Technology Utilization Officer
Manned Spacecraft Center
Houston, Texas 77058
Reference: B67-10112

Patent status:

No patent action is contemplated by NASA.

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